

Hierarchically Structured Ecobionanocomposites

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Green polymer composites can be produced through ecologically responsible conversion of renewable resources using industrial biotechnology and enhanced by nanotechnology. This triple technological convergence results in an emerging class of bioplastics known as Ecobionanocomposites. Polylactide-grafted-cellulosic nanowhiskers are embedded in a matrix of the opposite stereoisomer of the polymer to create a new and novel type of nanocomposite. The supramolecular cellulosic nanowhiskers, having molecular weights in the billions, are embedded in the complementary matrix through a stereocomplexed interfacial region. Poly(D-lactide)-graft-cellulose embedded in a poly(L-lactide) matrix shows clear evidence of stereocomplex formation as observed by DSC and FTIR. Three separate crystal structures are present in the hierarchical structures – cellulose, PLA homopolymer, and PLA stereocomplex. Combined wide and small angle x-ray scattering are used to understand the hierarchical structure. Significant increases in the heat distortion temperature and other properties of are achieved using this new hierarchical structuring approach.